

# International R&M/Safety Cooperation Lessons Learned between NASA and JAXA

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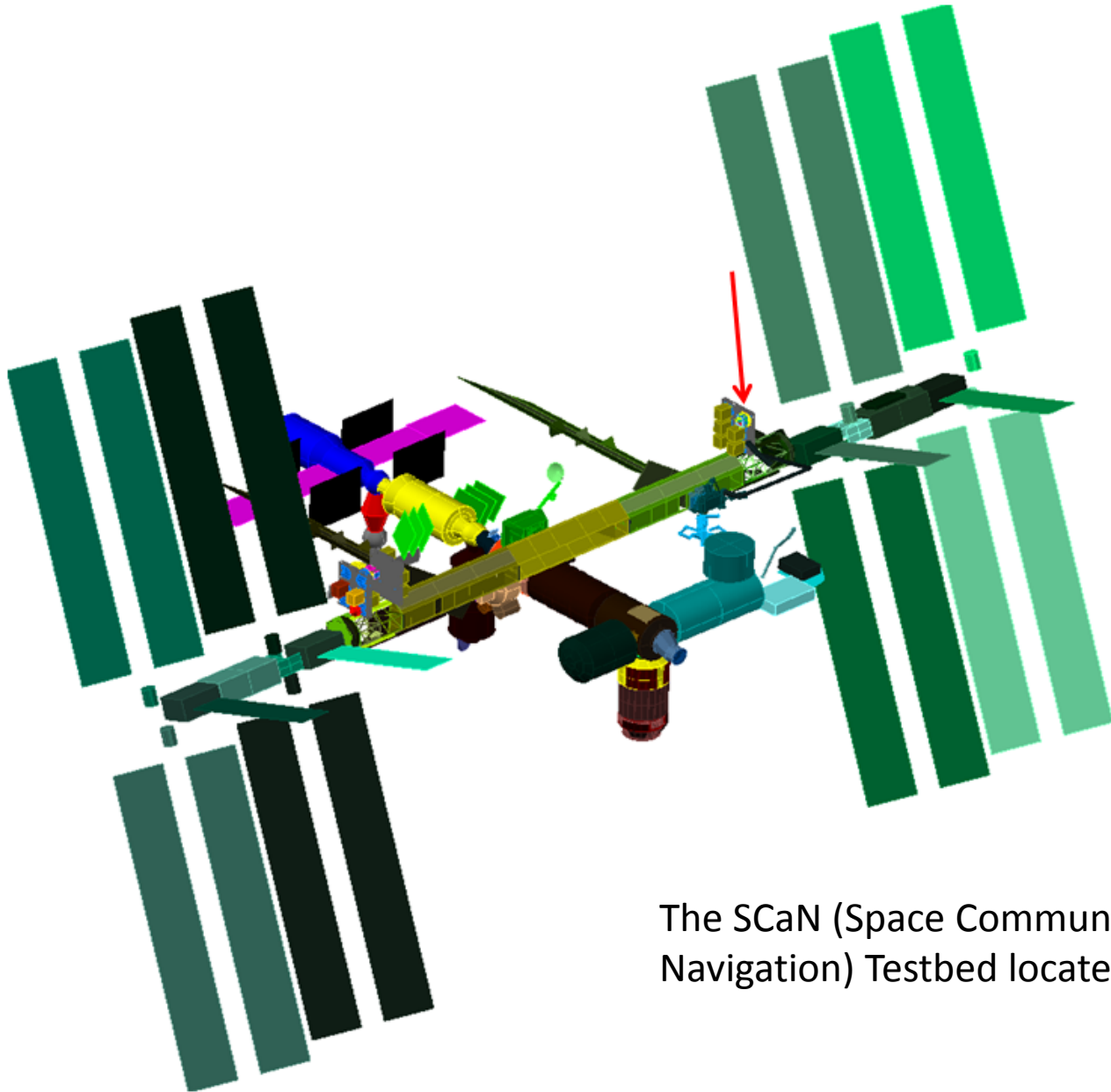
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# Overview & Outline

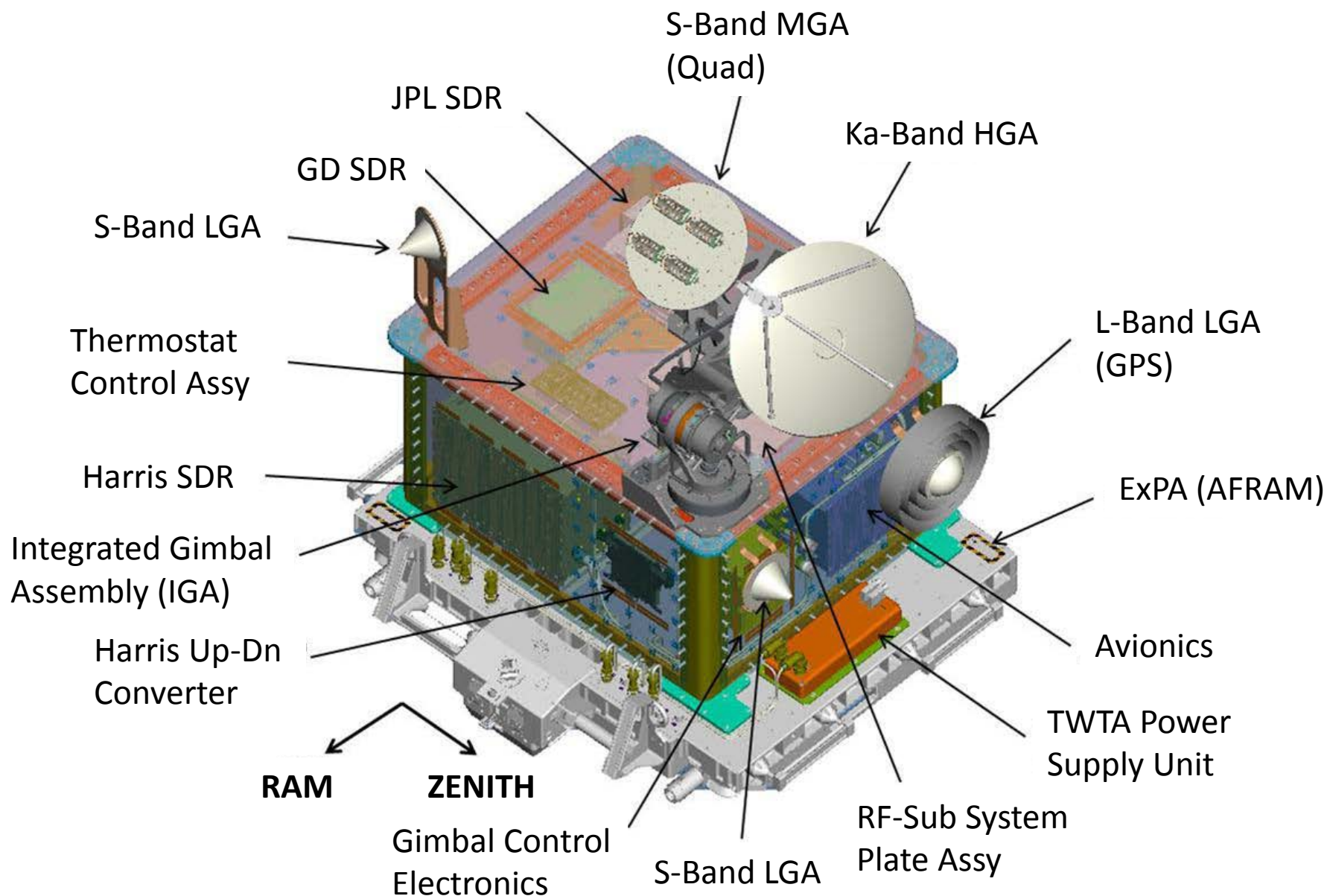
- Introduction
- Unique Challenges In Working With JAXA
- Interpretational Differences
- Problem Resolution
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- Summary & Conclusions
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# Background & introduction



The SCaN (Space Communications and Navigation) Testbed located on the ISS

# SCaN Testbed, ExPA, Radios and Infrastructure



# Unique Challenges In Working With JAXA

- Languages
  - Latin Alphabet
  - Japanese writing system uses 3 main scripts (kanji, hiragana, & katakana)
- Cultural Differences
  - Casualness vs. formality
  - Socially prescribed order in interactions
- Time Zones (opposite sides of the world)
- ITAR/EAR Restrictions
  - Extra precautions in handling hardware, design & mission data associated with the hardware
  - All written & verbal communications are controlled
- Communication Formats
  - Paper, cellphones, and requirements interpretation & verification

# INTERPRETATIONAL DIFFERENCES

- Project Requirements
  - Requirements & verifications that were not directly tied to the SMA Requirements (Safety & Reliability), were secondary & did not have to be distributed without a need to know
  - Proprietary, &/or ITAR/EAR
- Safety and Reliability Requirements
  - JAXA safety requirements were applicable only for the ground processing through HTV separation from the launch vehicle
  - Same documents as required by NASA were also mandatory for JAXA (hazard reports, safety data packages), and in addition they required unique safety compliance matrices
  - JAXA required completion & submittal of a PHA as part of the total safety deliverable
- Methodology and Practices
  - JAXA does not operate via a “close to the safety verification tracking log” and tracked to closure. So no Phase III ground /launch safety review until all verifications are closed
  - JAXA performs a significant amount of evaluation prior to ground/launch safety reviews, such that the reviews themselves are short & concise

# PROBLEM RESOLUTION

- Cultural Differences addressed via 1 to 2 hour courses based on lessons learned from previous visits to Japan, & Kennedy Space Center (KSC) experiences during the integration and turnover of payloads on HTV-2
- An External Interfaces Team worked with the ISS Office and International Partners (Russian Space Agency, JAXA, Canadian Space Agency and European Space Agency)
- HTV exposed pallet was in co-development with the SCaN Testbed resulting in numerous discoveries in the integration of the payload. This required many external interface meetings
- SCaN Testbed was the first Flight Releasable Adaptor Mechanism (FRAM) based payload to be integrated & launched at TNSC resulting in numerous discoveries throughout the physical & analytical integration. Required at the launch site were all the required FRAM handling & critical lift equipment, procedures & training. As above, many coordination meetings & emails were required.
- 4 weeks of work in testing & preparing the payload for turnover at the TNSC site: the Ground Processing Team developed a successful work tempo to each work day-1<sup>st</sup> an early morning coordination meeting was held by the Team at the hotel where all the members were collocated; 2<sup>nd</sup> after arrival at the TNSC site, issues & problems were addressed directly between the SCaN Testbed's JAXA Test Manager, & the JAXA's NASA Interface lead.



# SCaN Testbed Ground Processing Teams





# LESSONS LEARNED

- Project benefitted from the adoption of previous Lessons Learned. Observations of the HTV-2 ground processing, led to a method of moving the SCaN Testbed & Ground Support Equipment without assistance from JAXA
- It is important to have a clearly understood communication channel/process to allow for resolution of questions & issues prior to the JAXA safety reviews
- When working with JAXA, if agreements in work responsibilities or understanding of positions on topics is not captured in the protocols & action items, there can be confusion in what is expected to be completed (and when).

# LESSONS LEARNED (concluded)

- Having a defined verification & validation process made completion of processing all the verification requirements possible. But it was important that all parties that needed to weigh-in on the verifications were part of the process, otherwise the verifications had to be revisited & possibly redone
- Based on lessons learned, the HTV-4 Team will adopt the SCaN Testbed's methodology for the integration & ground processing of one payload & two ORUs
- Having a thorough, well documented, and configuration controlled set of reliability analysis is invaluable for avoiding “near misses” from a safety, reliability, and programmatic viewpoint

# Successful launch on H-IIB from TNSC



# Summary & Conclusions

- Selected important experiences gained & lessons learned from the collaboration of the National Aeronautics and Space Administration (NASA) and the Japanese Aerospace Exploration Agency (JAXA) on the CoNNeCT Project's SCaN Testbed were presented.
- This paper is the final status update of two 2012 RAMS papers about the SCaN Testbed that were presented (one on Ground Support Equipment Reliability & System Safety, and the other one on combined application of System Safety & Reliability for the flight system).
- The SCaN Testbed has been successfully assembled, integrated, tested, shipped, launched and installed on the ISS without incident.
- The steps taken to facilitate international understanding, communication, and coordination were successful and hopefully these lessons learned can be used by others in the Spaceflight R&M community on future missions.



# Installation and Checkout



# Next steps and future work



*Experiments & Operations*